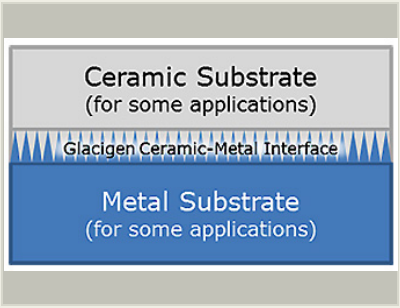
Ceramic-Metal Interfaces by Functional Grading, Phase I

Completed Technology Project (2017 - 2017)

Project Introduction

Glacigen Materials proposes a novel technique for producing large-area sheets of functionally graded materials (FGM), which yield robust ceramic-metal interfaces capable of withstanding harsh environments that include high temperatures. Propulsion systems offer some of the harshest possible design conditions from a materials perspective and the demands placed on engineering materials will become more rigorous in future systems. The combination of structural and environmental constraints often dictate that ceramics and metals be used synergistically. Unfortunately, the limitations of ceramic-metal joining are exacerbated in these same environments where simultaneous use of ceramics and metals would be most useful. Large discrepancies in thermal expansion coefficients and near-planar interfaces lead to delamination and spallation even in the best engineered bonds. As a novel approach to this problem, Glacigen will create robust C-M interfaces by grading from one material phase to the other through a tailorable thickness. The technique is materials flexible, enjoys exceptional damage tolerance, and can accept significant mismatches in thermal expansion coefficients. The method for producing FGM sheets presented in this proposal will have the added advantage of controlled anisotropic properties within the sheets. In particular, it is anticipated that this new material system will be particularly valued for its damage tolerance at the interface where up to 96% of the interface can be destroyed before contact area is reduced to that of a planar joint with the same footprint. A second point of unique value will lie in the utility of engineered anisotropy where through thickness thermal conductivity is expected to be dramatically higher than in-plane thermal conductivity. Phase I efforts will demonstrate fabrication of these sheets and will include the characterization of mechanical, thermal, and functional properties.



Ceramic-Metal Interfaces by Functional Grading, Phase I Briefing Chart Image

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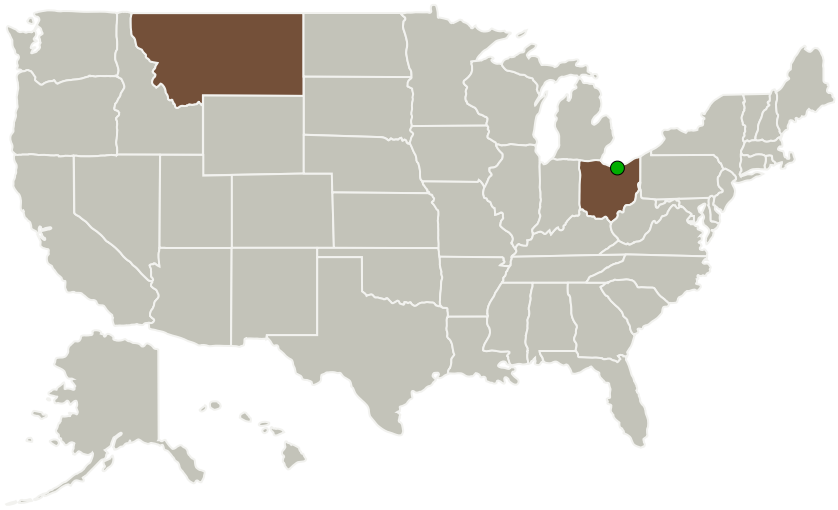
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Glacigen Materials, Inc.	Lead Organization	Industry	Belgrade, Montana
Glenn Research Center(GRC)	Supporting Organization	NASA Center	Cleveland, Ohio

Primary U.S. Work Locations	
Montana	Ohio

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Glacigen Materials, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

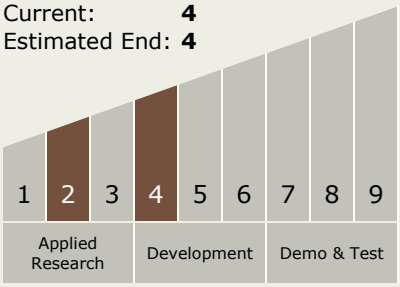
Carlos Torrez

Principal Investigator:

David Driscoll

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



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Images

Briefing Chart Image
Ceramic-Metal Interfaces by Functional Grading, Phase I Briefing Chart Image
(https://techport.nasa.gov/image/135035)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.1 Materials
    - TX12.1.6 Materials for Electrical Power Generation, Energy Storage, Power Distribution and Electrical Machines

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System